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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/594,907	08/07/2008	Takeshi Sakamoto	46884-5519 (232060)	8322

55694 7590 01/29/2010

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EXAMINER	
JUNG, MICHAEL	

ART UNIT	PAPER NUMBER
2895	

MAIL DATE	DELIVERY MODE
01/29/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/594,907	SAKAMOTO ET AL.	
	Examiner	Art Unit	
	MICHAEL JUNG	2895	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 December 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) *16-19* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 September 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20090423; 20090324; 20080929; 20060929*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-15 (Group I) in the reply filed on 12/07/2009 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Priority

2. Receipt is acknowledged of certified foreign priority papers submitted in the PCT application no. PCT/JP05/005554, which the instant application seeks priority to.

Information Disclosure Statement

3. The information disclosure statements (IDS) submitted on 09/29/2006, 09/29/2008, 03/24/2009 and 04/23/2009 are in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statements are being considered by the examiner.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-15 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 is indefinite, because it is unclear how a second modified region is between the first modified region closest to a rear face of the substrate and the rear face. As recited in claim 1, the second modified region would be situated between the first modified region (which is recited to be the closest to the rear face) and the rear face; as a result, the first modified region would not be closest region to the rear face. For the purposes of advancing the examination, the examiner interprets the claim 1 as meaning "forming at least one row of a second modified region along the line to cut at a position between the first modified region closest to the front face of the substrate and the rear face...".

Claim 7 is indefinite, because claim 7 recites energy without appropriate unit of energy. For the purposes of advancing the examination, the examiner assumes the unit of energy to be microJoule (μJ).

Claim 8 is indefinite, because a distance of the light-converging point does not have a reference or a datum to measure the distance from.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Japanese Patent Pub. No. JP 2004-001076 to Naoki (hereinafter "Naoki").

Regarding claim 1, Naoki teaches a laser processing method (see Drawing 23) of

irradiating a substrate 15 (para [0075]) having a front face 6 (para [0052]) formed with a laminate part 4 (para [para [0022]) including a plurality of functional devices (para [0072] - "...the semiconductor layer laminated for elements exists in many cases...integrated circuit elements..."; see Drawing 23; see also para [0052].) with laser light L ("L" in Drawing 23; para [0022] discloses that "L" stands for laser beam.) while locating a light-converging point P (see Drawing 23) within the substrate 15 (para [0331]) so as to form a modified region 8 (para [0073] - "cut starting point domain") to become a start point for cutting within the substrate 15 along a line to cut (a line that overlaps the melting treatment regions 13 in the thickness direction of the substrate 15; para [0076] - "...If the crack by the melting treatment area 13 is grown up into the thickness direction...the wafer 1a can be also separated.) of the substrate 15,

the method comprising the steps of:

forming a plurality of rows of first modified regions 13, 13 (para [0075]; Drawing 23 shows a row 13 closest to the front surface 6 and a "middle" row 13.) along the line to cut; and

forming a least one row of second modified region 13 (para [0075]; Drawing 23 shows a row 13 farthest from the front surface 6) along the line to cut at a position between the first modified region 13 closest to a front face 6 of the substrate 15 and the rear face 21 (see Drawing 23), so as to generate a fracture extending along the line to cut (para [0076] - "...If the crack by the melting treatment area 13 is grown up into the

thickness direction...the wafer 1a can be also separated) from the second modified 13 region to the rear face 21.

Regarding claim 2, Naoki further teaches the substrate 15 that is a semiconductor substrate (para [0052] - "semiconductors (Si)"), and the first and second modified regions 13, 13, 13 that include a molten processed region (para [0075] - "...melting treatment areas 13 are formed in the thickness direction of the substrate 15...").

Regarding claim 3, Naoki further teaches the first and second modified regions 13, 13, 13 that are successively formed one by one from the side farther from the rear face 21 while using the rear face 21 as a laser light entrance surface (see Drawing 23).

Regarding claim 4, Naoki further teaches the laser light that has an energy of 2 to 50 μJ (para [0032] - "Output: 20 microJ/pulse") when forming first modified regions.

Regarding claim 5, Fukuyo further teaches the laser light that has an energy of 1 to 20 μJ (para [0032] - "Output: 20 microJ /pulse") when forming the second modified regions.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 6-10, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naoki.

Regarding claim 6, Naoki discloses that the laser beam penetrates not less than 80% into the silicon substrate 15 (para [0035]). In other words, the energy of a laser beam attenuates as it penetrates into the silicon substrate 15. Thus, it would have been obvious to one of ordinary skill in the art that it would take more energy to form a modified region deeper in the silicon substrate than to form shallower modified regions.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to employ a laser light having a greater energy when forming the first modified regions than when forming the second modified regions as taught by Naoki, so as to keep the size of the modified regions relatively similar to each other as shown in Drawing 23.

Regarding claim 7, Naoki neither specifies the energy of the laser light for forming the first modified region that is 1.6 to 3.0 μJ nor the energy of the laser light for forming the second modified region that is 1 μJ.

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1x10^{8}$ W/cm^2 and $1x10^{12}$ W/cm^2 to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14x10^{-8}$ cm^2 (para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields an energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the first modified region than the second modified region (that is, the first modified region is situated deeper in the substrate than the second modified region.), it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the first modified region that is 1.6 and 3.0 μJ and the energy of the laser for forming the second modified region that is 1 μJ, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 8, Naoki discloses the light-converging point P of the laser light L that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the respective portion where the light-converging point of the laser light is located when forming neighboring first modified regions 13, 13 have a distance of 24 to 70 microns therebetween.

Regarding claim 9, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located at a position distanced by

50 micron to 180 micron from the rear face 21 when forming the first modified regions 13, 13.

Regarding claim 10, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located at a position distanced by 20 micron to 110 micron from the rear face 21 when forming the first modified regions 13, 13.

Regarding claim 14, Naoki discloses the light-converging point P that is located in about half way in between the substrate in the substrate thickness direction. Since Naoki teaches that the substrate 15 can have various thicknesses such as 100 microns (para [0033] and [0034]), it would have been obvious to one of ordinary skill in the art that the light-converging point P of the laser light L is located when forming the second modified region 13 closest to the rear face 21 of the substrate 15 is distanced from the rear face 21 by 20 micron to 110 micron, and a position where the light-converging point P of the laser light L is located when forming the second modified region second closest to the rear face 21 of the substrate is distance from the rear face by 140 microns or less (see Drawing 23).

Regarding claim 15, Naoki further teaches the step of cutting the substrate 15 and the laminate part 4 along the line to cut (para [0076]).

7. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Naoki and further in view of European Patent Pub. No. EP 1 338 371 A1 to Fukuyo.

Regarding claim 11, Naoki discloses that the laser beam penetrates not less than 80% into the silicon substrate 15 (para [0035]). In other words, the energy of a laser beam attenuates as it penetrates into the silicon substrate 15. Thus, it would have been obvious to one of ordinary skill in the art that it would take more energy to form a modified region deeper in the silicon substrate than to form shallower modified regions.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to employ a laser light having a greater energy when forming the first modified regions than when forming the second modified region as taught by Naoki, so as to keep the size of the modified regions relatively similar to each other as shown in Drawing 23.

Naoki does not explicitly disclose forming a plurality of rows of second modified regions.

However, Fukuyo teaches forming a plurality of rows of modified regions that is more than three rows as disclosed in the Drawing 23.

At the time of the invention, it would have been obvious to one of ordinary skill in the art to modify the method of forming modified regions of Naoki by forming more than three rows of the modified regions as taught by Fukuyo, so as to cut a thicker substrate and/or to make it easier to generate and extend a crack that reaches both sides of the substrate (Naoki, para [0036]).

Regarding claim 12, the modified method of Naoki and Fukuyo does not disclose the energy of the laser light for forming the second modified region farthest from the rear face of the substrate that is 1.3 to 3.3 μJ; or the energy of the laser light for forming the second modified region closest to the rear face of the substrate that is 1 μJ.

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1x10^{8}$ W/cm^2 and $1x10^{12}$ W/cm^2 to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14x10^{-8}$ cm^2 (para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields the energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the second modified region that is farthest from the rear face of the substrate than the second modified region that is closest to the rear face (that is, the second modified region farthest from the rear face is situated deeper in the substrate than the second modified region closest to the rear face.). Furthermore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the second modified region farthest from the rear face of the substrate that is 1.3 and 3.3 μJ and the energy of the laser for forming the second modified region closest to the rear face of the substrate that is 1 μJ, since it has been held that discovering an optimum value of a

result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Regarding claim 13, the modified method of Naoki and Fukuyo does not disclose the energy of the laser light for forming the first modified region that is 1.3 to 3.3 μJ; or the energy of the laser light for forming the second modified region closest to the rear face of the substrate that is 1 μJ.

However, Naoki teaches locally heating a substrate by depositing a laser power density between at least $1x10^{8}$ W/cm^2 and $1x10^{12}$ W/cm^2 to form a "melting treatment area" (para [0031]). Moreover, a pulse width of the laser is between 1 to 200 nanoseconds (para [0031]) and a laser light-spot cross-section area is $3.14x10^{-8}$ cm^2 (para [0032]). The product of the laser power density, the pulse width and the laser light-spot cross-section yields the energy of the laser.

The energy of the laser is a result effective variable. In light of Naoki's teaching (see rejection of claim 6), it would have been obvious to one of ordinary skill in the art that it would take more energy to form the first modified region than the second modified region that is closest to the rear face (that is, the first modified region is situated deeper in the substrate than the second modified region closest to the rear face.). Furthermore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to select the energy of the laser for forming the first modified region that is 1.3 and 3.3 μJ and the energy of the laser for forming the second modified region closest to the rear face of the substrate that is 1 μJ, since it has been held that

discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MICHAEL JUNG whose telephone number is (571) 270-3345. The examiner can normally be reached on Mondays through Fridays from 8:30 AM to 6:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Richards can be reached on (571) 272-1736. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MICHAEL JUNG/
Examiner, Art Unit 2895
18 December 2009

/N. Drew Richards/
Supervisory Patent Examiner, Art Unit 2895